

**Notice of Allowability**

Application No.

10/621,668

Applicant(s)

BALIGA, BANTVAL JAYANT

Examiner

Beth E. Owens

Art Unit

2824

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to \_\_\_\_.
2. ☒ The allowed claim(s) is/are 24-32.
3. ☒ The drawings filed on 17 July 2003 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some\* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),  
Paper No./Mail Date 07/17/2003
4. ☐ Examiner's Comment Regarding Requirement for Deposit  
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_.

  
RICHARD ELMS

SUPERVISORY PATENT EXAMINER

TECHNOLOGY CENTER 2800

### **Examiner's Amendment**

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to Applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

#### In the Claims:

Claim 24, lines 6, 12, 14 and 17: delete "first" before "sidewall".

Claim 24, line 8: replace "a first electrically" with --an electrically--.

Claim 24, lines 11 and 13: delete "first" before "portion".

Claim 24, lines 11 and 13: delete "first" before "electrically".

Claim 24, line 17: delete "a".

Claim 26, line 2: replace "comprise" with --comprises--.

Claim 26, line 4: delete "first" before "sidewall".

Claim 28, line 2: delete "first".

Claim 29, lines 5 and 9: delete "first" before "sidewall".

Claim 32, line 2: delete "first" before "sidewall".

Claim 32, line 2: replace "a first electrically" with --an electrically--.

Claim 32, line 4: delete "first" before "electrically".

#### In the Specification:

Page 1, line 2: insert --now U.S. Patent No. 6,621,121,-- after "2001,".

2. Authorization for this examiner's amendment was given in a telephone interview with Grant Scott on March 18, 2004.

3. Claims 24-32 are allowed.

4. Claims 1-23 were cancelled by preliminary amendment filed 17 July 2003.

5. The following is an examiner's statement of reasons for allowance:

There is no prior art available nor obvious motivation to combine elements of prior art which teach a method of forming a vertical MOSFET, comprising the steps of: forming a base region of second conductivity type in a semiconductor substrate having a drift region of first conductivity type therein that forms a P-N junction with the base region; forming a source region of first conductivity type in the base region; forming a deep trench having a sidewall that extends adjacent the base region, in the semiconductor substrate; lining the deep trench with an electrically insulating layer; refilling the lined deep trench with a trench-based source electrode; selectively etching the trench-based source electrode to define a shallow trench therein and expose a portion of the electrically insulating layer that extends on the sidewall of the deep trench; selectively etching the portion of the electrically insulating layer to expose an upper portion of the sidewall of the deep trench and reveal the base region; lining the shallow trench with a gate insulating layer that extends on the exposed upper portion of the sidewall of the deep trench and bottom and sidewalls of the shallow trench;

forming a gate electrode that extends on a surface of the semiconductor substrate and extends into the lined shallow trench; and forming a surface source electrode that electrically connects the trench-based source electrode, source region and base region together;

and:

A method for forming a vertical MOSFET, comprising the steps of: forming a semiconductor substrate having therein a drift region, a transition region on the drift region, a base region on the transition region and a source region on the base region; forming a deep trench having a sidewall that extends adjacent the base, transition and drift regions, in the semiconductor substrate; forming a trench-based source electrode in the deep trench; forming a shallow trench that exposes the base region and source region extending along the sidewall, in the trench-based source electrode; forming a gate oxide insulating layer on the exposed base region; forming a gate electrode that extends on an upper surface of the semiconductor substrate and extends into the shallow trench; and forming a surface source electrode that electrically connects trench-based source electrode, source region and base region together.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

*Conclusion*

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Beth E. Owens, Ph.D. whose telephone number is 571.272.1882.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms, can be reached on 571.272.1869. The fax phone number for the organization where this application or proceeding is assigned is 703.872.9306 for official communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 571.272.2800.

BEO 03.19.04